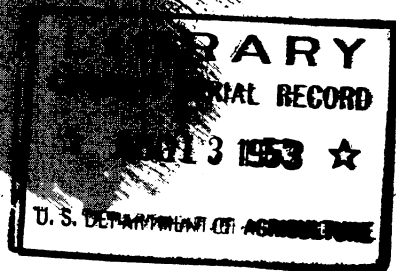


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# The *Hessian* FLY



Farmers' Bulletin No. 1627

U. S. DEPARTMENT OF AGRICULTURE

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This bulletin is a revision of Farmers' Bulletin 1627, The Hessian Fly and How To Prevent Losses From It. Earlier editions were prepared by W. R. Walton and C. M. Packard.

# THE HESSIAN FLY

## And How Losses From It Can Be Avoided

By W. B. CARTWRIGHT and E. T. JONES, *entomologists, Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration*

**T**HE HESSIAN FLY<sup>1</sup> is the most destructive insect enemy of wheat in the United States. Local outbreaks occur nearly every year, and widespread damage can be expected at irregular intervals, sometimes as often as every 5 or 6 years. Damage estimated at \$100 million in a single year has been caused by this pest.

Island, N. Y., in 1779, in the vicinity of Lord Howe's encampment of 3 years before. It was believed that the Hessians in his army had brought the pest from Europe in the straw used for their bedding.

### DISTRIBUTION

The map (fig. 1) shows the major distribution of the hessian fly in the

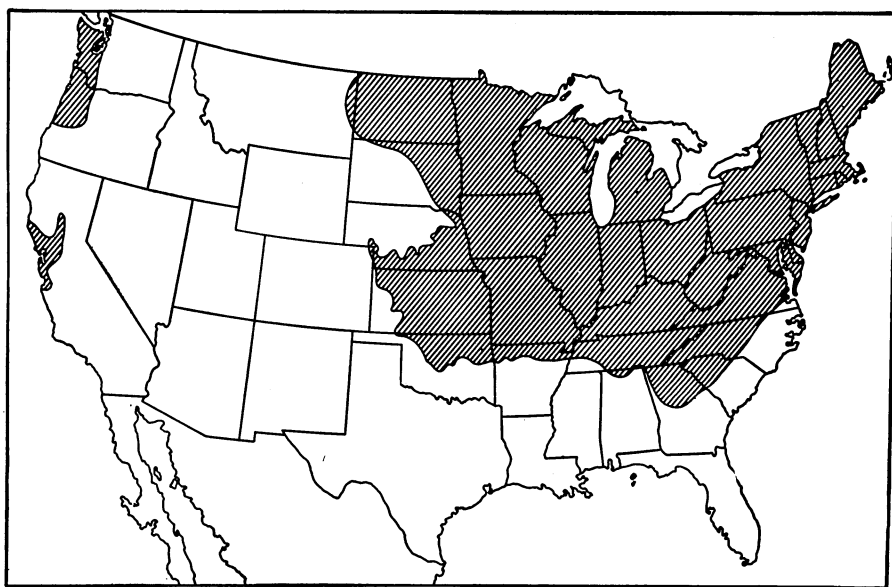


Figure 1.—Major distribution of the hessian fly in the United States.

Although the hessian fly is injurious chiefly to wheat, at times it causes some damage to barley and rye. It does not attack oats. It has been found in grasses, but it does not infest them heavily.

This insect was given its common name long ago by Americans because of its depredations on Long

United States. In some years this fly is found in other areas. It is most destructive where it occurs east of the Rocky Mountains. It caused serious losses of wheat in central Georgia for several years, including 1951, and considerable infestation in barley and wheat was reported from San Diego, Calif., in 1952.

<sup>1</sup> *Phytophaga destructor*.

The hessian fly is also found from Prince Edward Island west across southern Canada. Outside of North America it is known in northern Africa, western Asia, Europe, Great Britain, and New Zealand.

### NATURE OF INJURY

Injury by the hessian fly to wheat and other grains is caused by the feeding of the maggots between the leaf sheaths and the stems. They



Figure 2.—Young wheat plants infested with larvae and flaxseeds of the hessian fly.

extract the juices of the young stems, causing the death of small tillers, and so weakening the older stems that they break over shortly before harvest when the heads have grown heavy with grain. In serious infestations of the fall brood much of the young wheat is killed outright or so weakened that it cannot survive the winter. The maggots of the spring brood may also kill the plants in the same way, but their most obvious damage is to cause the breaking over, or "lodging," of the stems after they have developed heads. Not only are the quality and yield of the grain reduced, but many such heads fall over and are missed by the harvesting machinery.

Infested young plants are shown in figure 2. An uninfested plant is more slender, the green color is lighter, the stems are more visible, and the central unrolling leaf is present; leaves droop, and the tillers spread out and cover the ground. In an infested tiller the leaves are more erect, broader, usually shorter, and of a darker green. Tillers infested in the fall usually perish during the winter.

If a young tiller of an infested plant is attacked after it appears above ground, it has the same appearance as the original shoots. Its leaves become broader and darker. This applies equally to a severe attack on fall wheat in spring or on young spring wheat. Later the infested tillers change to yellow and then to brown. At this time the small maggots or puparia may be found just above the bases or joints of the stems.

### DESCRIPTION AND HABITS

The egg is only about  $1/50$  inch long, but it may be readily seen by one having ordinarily good sight. It is slender and almost cylindrical, with both ends bluntly rounded.

The surface is a glossy red, the color deepening with age. The eggs (fig. 3) are usually placed in the grooves of the upper surface of the leaves.

The newly hatched larva, or maggot, is of about the same size as the egg. It is also reddish, but changes to white within a few days. Immediately after hatching, the maggot makes its way down the leaf and behind the sheath. In young wheat it descends to just above the roots, but after the plants have begun to joint it can go no farther than the base of the sheath of that particular leaf, which is always at a joint.

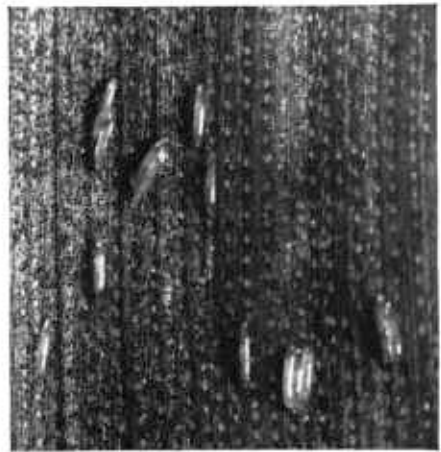


Figure 3.—Eggs of the hessian fly.  
Much enlarged.

Where abundant the larvae crowd together side by side or behind one another under the same sheath.

When the larva becomes full-grown, it is smooth, glistening, and white with a translucent greenish stripe down the middle of the back where the stomach contents show through (fig. 4). The skin soon hardens and turns brown, forming a puparium, which closely resembles a flaxseed and is often so called (fig. 4). The pupa (fig. 5) is formed after the larva has reversed its position inside the flaxseed and lies with the head pointing upward.

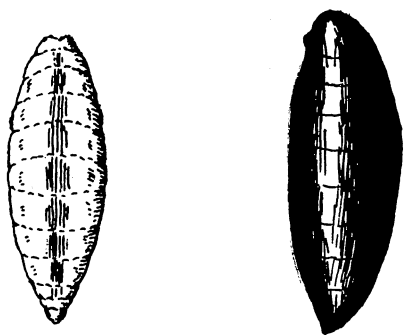


Figure 4.—Hessian fly larva and flaxseed.  
Enlarged.



Figure 5.—Hessian fly pupa, removed from  
the flaxseed. Enlarged.

The fall brood of larvae and the overwintering flaxseeds are found below the surface of the ground just above the roots. Those of the spring brood are found in different locations, depending upon the maturity of the plants. Many of the larvae and flaxseeds become established just above the joints under the leaf sheaths.

If the flaxseed is not situated conveniently for the emergence of the adult, the pupa may push itself to a

point of escape. Frequently the empty pupal skins may be observed protruding from under the sheaths of leaves.

The adult fly is very minute and resembles a small mosquito or gnat (figs. 6 and 7). Many insects, especially other gnats, seen in the fields by growers are mistaken for hessian flies. During warm days in the egg-laying season they may be observed flying about in the young wheat and alighting and laying eggs upon the leaves. On cooler days, or in early morning when there is a heavy dew, they are down among the leaves or even on the ground. The flies live only a few days.

#### LIFE HISTORY

In the winter-wheat areas of this country the hessian fly has two principal generations annually, in the spring and the fall (fig. 8). The flies pass the winter in the young wheat, mostly in the resting, or flaxseed, stage, but in mild winters some larvae from two-thirds to full-grown may overwinter.

In spring (from March in Georgia and South Carolina to May in Michigan) the flies emerge from the flaxseeds, deposit their eggs on the wheat, and the young form flaxseeds before harvest. Most of these flaxseeds remain in the stubble during the summer.

In some seasons there appears before harvest a supplementary brood of flies that have delayed emerging from overwintered puparia or have issued from the spring puparia. Sufficient rainfall and humidity to cause germination and vigorous growth of volunteer wheat may also cause a late summer brood of flies to develop. These flies may infest wheat planted in the fall or the following spring.

In normal weather adult flies begin to come out of the stubble in late August and early September. Stragglers may continue to issue as late as the first of December in the latitude of Georgia and South Carolina, but in most Northern States few flies emerge after September. Most of them usually appear and disappear within a week or so—early enough in the fall for wheat planting to be delayed until danger of infestation is past.

The flies prefer to deposit their eggs on the younger plants, those having from one to three leaves. The fall brood of maggots hatching from these eggs make their way downward nearly or quite to the root crowns. Usually they complete their development as larvae, and form puparia in which they spend the winter on the young wheat plants. The earliest deposited eggs on the earliest sown wheat may produce adults before winter, and in this case the delayed individuals emerging from stubble or volunteer wheat combine with them to produce another so-called supplementary generation. The importance of this supplementary generation depends largely on the weather. When winter sets in before the larvae have matured sufficiently to withstand its rigors, they perish, but if the mild fall weather is greatly prolonged, a number of them may winter over.

### EFFECT OF WEATHER ON THE HESSIAN FLY

Many wheat growers believe that cold weather in the fall terminates the activities of the flies, and they try to delay sowing wheat until after there has been a sharp frost. There is some ground for this belief, since emergence of flies already in the pupal stage, egg laying, and development of the young mag-

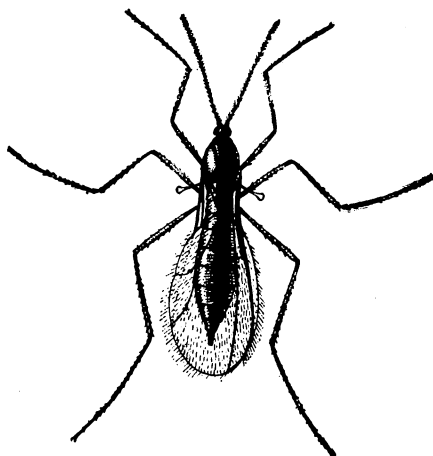


Figure 6.—Hessian fly female. Enlarged.

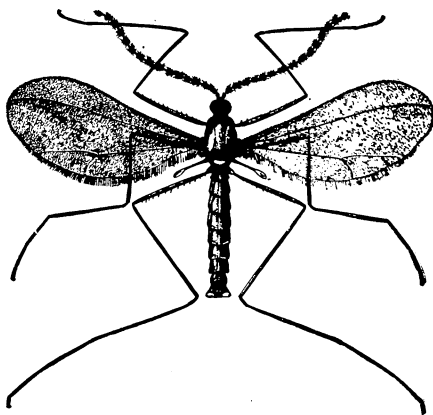


Figure 7.—Hessian fly male. Enlarged.

gots are retarded by such low temperatures. Also maggots that have not begun to pupate inside their flaxseeds will not do so while the average daily temperature remains much below 50° F. Warmer periods during the fall, however, may allow considerable fly activity.

Egg laying sometimes takes place in rather chilly weather, and the eggs have been known to remain in a temperature of 36° F. for several hours with no other effect than a



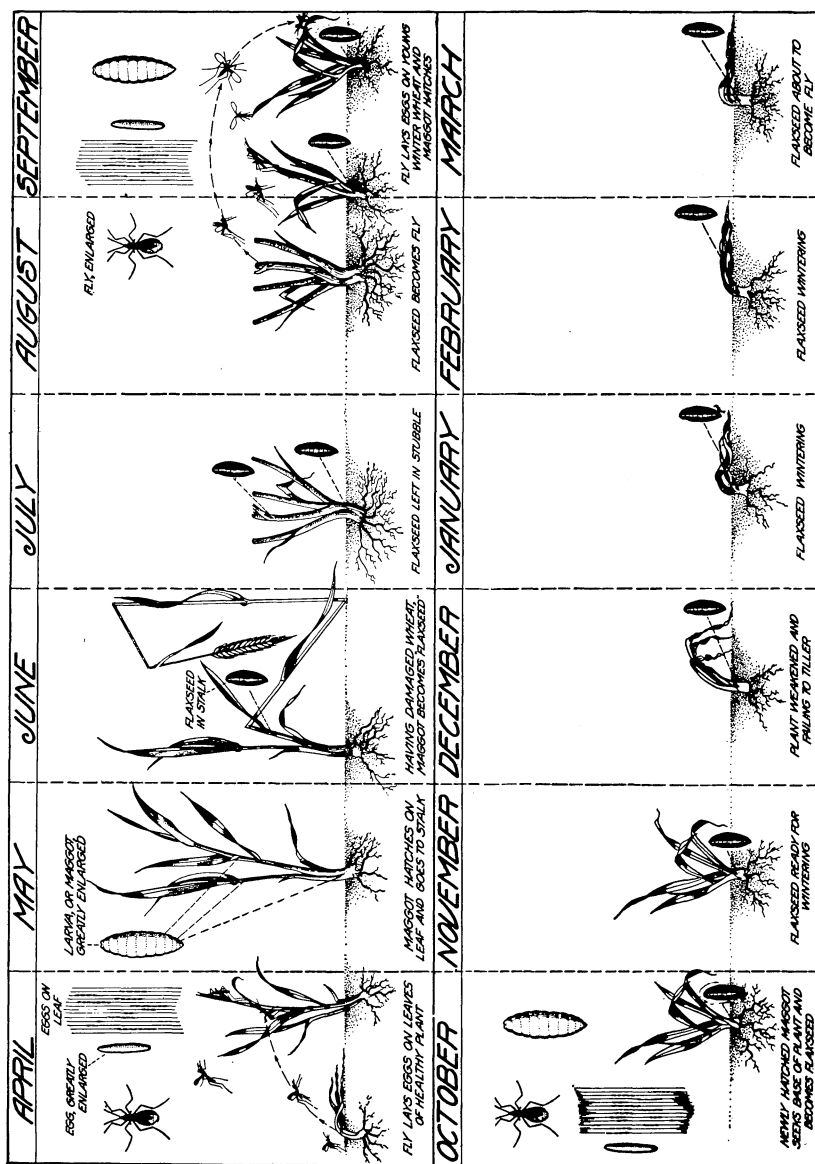


Figure 8.—Seasonal development of the hessian fly.

delay in hatching. Eggs have been observed hatching in the daytime in fields when there was frost nearly every night. Though the freedom of late-sown wheat from attack by the fly may be attributed partly to frosty weather, most of the adult flies are dead by the time severe frosts occur.

Heat and drought have a marked effect on the hessian fly. Under dry conditions the larvae in the flaxseeds may survive for 2 years or more and afterwards emerge as adults. Drought delays the emergence of the adult flies in the fall. This fact is of special importance in the North, where it is necessary

to get the wheat sown early to enable the plants to withstand the severe winter weather. Extreme summer heat combined with dryness prevents this insect from surviving in the more arid sections of the West and Southwest.

### NATURAL ENEMIES

Thirty-five species of insects parasitize the immature stages of the hessian fly in this country, but many of these species are rather rare. Figure 9 shows the wasp *Eupelmus allynii*, one of the most common parasites. Though 75 percent or more of the flaxseeds are sometimes destroyed by parasites during the summer, the flies reproduce so fast that in favorable weather a serious infestation may still develop in the fall-planted wheat. Parasites may help materially to reduce hessian fly infestations, but ordinarily they do not keep the pest under control.

### CONTROL MEASURES

After the hessian fly has infested a wheatfield, it is too late to apply control measures. An infestation can be prevented, however, by

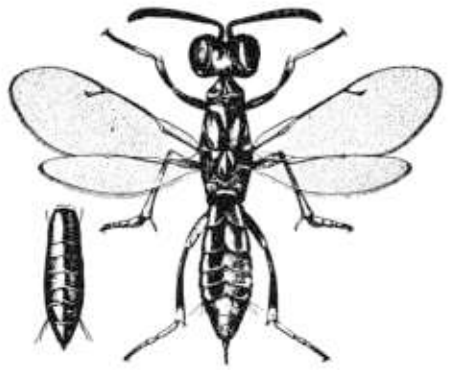


Figure 9.—*Eupelmus allynii*, a common parasite of the hessian fly. Enlarged.

following certain recommended practices, especially by planting whenever possible wheat varieties resistant to the hessian fly. Such practices are of greatest benefit when they are used throughout a neighborhood.

### Resistant Varieties of Wheat

High resistance to the hessian fly has been discovered and bred into wheats adapted to different areas where the fly is a serious problem (fig. 10). The resistant variety Big Club 43 and the variety Poso 48.

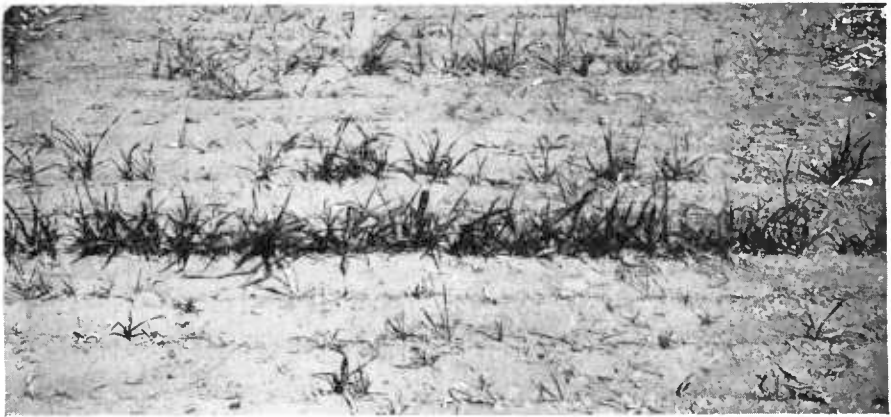


Figure 10.—Standing rows of young wheat are resistant to the hessian fly; other rows are susceptible. (Courtesy of Purdue Agricultural Experiment Station.)

which has some resistance to the fly, are adapted to certain parts of California.

Pawnee, a wheat having considerable fly resistance in addition to other desirable characters, was released to farmers in Nebraska in 1942 and in Kansas and Oklahoma in 1943. By 1949 this wheat had become the most widely grown variety in the United States.

### Safe Seeding Dates

One of the most practical and effective methods of avoiding fall infestation of wheat by the hessian fly is to delay seeding until most of the fall brood has disappeared. The safe date for seeding, sometimes called the fly-free date, varies in different parts of the country and even with local conditions. Safe

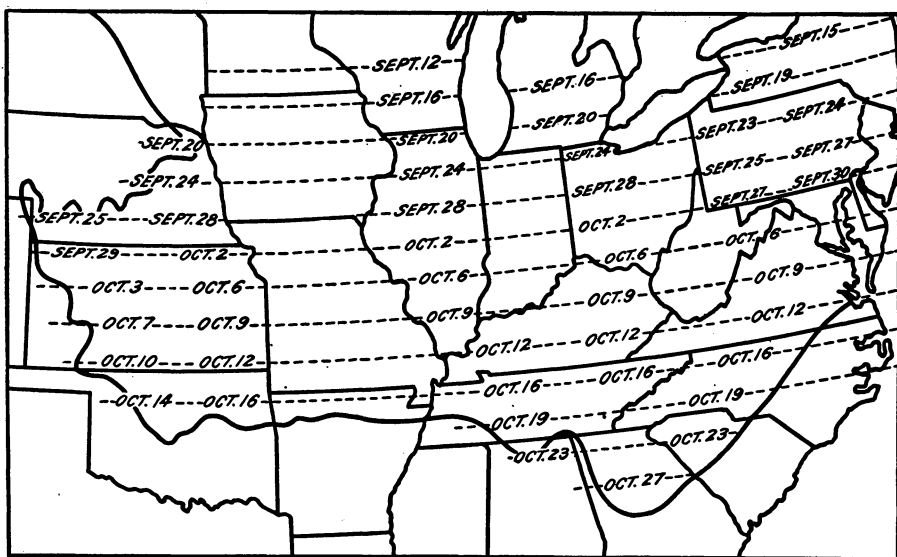


Figure 11.—Map showing average safe dates for planting wheat to avoid hessian fly injury.

Ponca wheat, released by the Kansas and Oklahoma agricultural experiment stations in 1951, is the most resistant variety of hard red winter wheat now available commercially. It is especially recommended for eastern Kansas and for Oklahoma except in the extreme northwestern part of the State.

Several soft red winter wheats that are resistant to the hessian fly are being developed and should soon be available. Farmers should consult their county agent or State agricultural experiment station regarding hessian fly resistant varieties of wheat adapted to their localities.

average dates to begin seeding are shown in figure 11, but these dates are only approximate and vary from year to year, depending on the weather. In some States, county agents or State agricultural experiment stations advise farmers each fall of the safe seeding dates for their localities.

### Destruction of Infested Stubble and Volunteer Wheat

Where it can be practiced, deep and thorough plowing under of infested stubble soon after harvest reduces the abundance of the pest. Afterwards the surface should be

harrowed or rolled to close the openings in the soil so that the flies cannot emerge.

This method of control is feasible in parts of the great wheat-growing areas west of the Mississippi River, but is not advised where the best crop rotations call for the sowing of grass or clover in the growing wheat, or where there is much blowing of the soil. After the ground has been plowed, it should be disked or otherwise treated, if necessary, to keep down the growth of volunteer wheat. Volunteer wheat serves as a breeding place for the flies during the summer, and they may build up a large population to infest wheat in the fall.

### **Crop Rotation**

If possible, wheat should not be grown on the same land 2 years in succession. Continuous planting of this crop increases infestation not only by the hessian fly but also by other insects such as the jointworm, the strawworm, and wheat stem sawflies. An approved rotation of crops should be practiced.

### **Cropping Practices**

Wheat can withstand hessian fly injury best when it is growing vig-

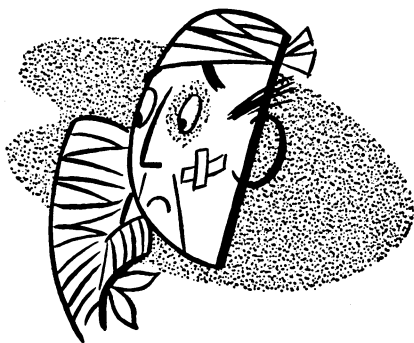
orously in well-prepared fertile soil. Such wheat produces tillers frequently and is most likely to outgrow a light attack of flies. Careful attention should therefore be given to proper preparation of the land, use of fertilizers, lime, and manure, and planting of good seed. Farmers should follow the latest recommendations for growing wheat that are available from their State agricultural experiment stations and the United States Department of Agriculture.<sup>2</sup>

### **Impractical Means of Control**

Many measures that have been suggested for the control of the hessian fly are useless or of very doubtful value. Burning the stubble to destroy the flaxseeds; rolling, pasturing, or mowing the young wheat to kill the immature stages of the insect; and early planting of trap strips or decoy plots of young wheat to concentrate the flies for later destruction by plowing have all proved to be ineffective or impractical. A satisfactory control of the hessian fly with insecticides has not yet been developed.

<sup>2</sup> See Farmers' Bulletin 2006, Wheat Production in the Eastern United States, issued September 1951.

# Farm Accidents Each Year . . .

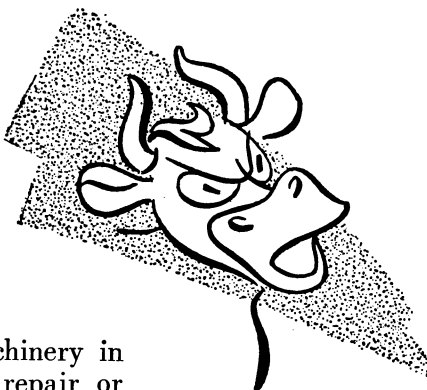


Kill about 15,000 people.

Injure or cripple about 1 $\frac{1}{4}$  million more.

Cause loss of 17 million man-days of farm labor, or the services of 46,000 men working every day for a year.

## Help Prevent Most of These Accidents!



Keep tractors and other farm machinery in good repair. Equipment in bad repair or carelessly handled ranks first in killing or injuring farm people.

Handle bulls and other farm animals carefully. They rank second in causing farm accidents and deaths.

Use sharp-edged tools with caution—sickles, saws, corn knives, chisels, screwdrivers, axes.

Take proper care in using, handling, and storing insecticides and other poisonous chemicals.

Install, use, and repair electrical appliances and equipment properly.

*You can lessen the seriousness of many accidents by immediate and proper care. Keep a first aid kit handy and know how to use it. Call a doctor.*